CLAIMS

1. A composition of matter comprising a defined dispersion of lactoferrin immobilized on a naturally occurring substrate via the N-terminus region of the lactoferrin.

2. The composition in accordance with claim 1, wherein the naturally occurring substrate is a protein, a polysaccharide, cellulose, a nucleic acid, a nucleotide, or a lipid.

3. The composition in accordance with claim 1, wherein the naturally occurring substrate is collagen, gelatin, fibronectin, casein, mucin, heparan-sulfate, carrageenan, deoxyribonucleic acid, adenosine triphosphate or a triglyceride.

SUB A2

4. The composition in accordance with claim 1, wherein the naturally occurring substrate is a galactose-rich polysaccharide.

5. The composition of claim 1, wherein the dispersion is an aqueous solution, an aqueous emulsion, a colloid, a suspension, a powder, or a granular solid.

SUB A3

6. The composition in accordance with claim 1, further comprising native lactoferrin.

7. The composition in accordance with claim 6, wherein the concentration of immobilized lactoferrin and native lactoferrin in the dispersion is from about 0.05% wt/vol to about 2.5% wt/vol.

8. The composition in accordance with claim 6, wherein the molar ratio of immobilized lactoferrin to native lactoferrin is a ratio of from about 1:1 to about 1:10.

9. The composition in accordance with claim 6, wherein the molar ratio of immobilized lactoferrin to native lactoferrin is a ratio of from about 1:1 to about 1:5.

SUB A4

10. The composition in accordance with claim 6, wherein the composition comprises about 1% wt/vol immobilized lactoferrin and about 1% wt/vol native lactoferrin.

11. The composition in accordance with claim 1, wherein the composition further comprises a buffer system.

12. The composition in accordance with claim 11, wherein the buffer system contains a physiologically acceptable acid, a physiologically acceptable base, and a physiologically acceptable salt.

13. The composition in accordance with claim 12, wherein the physiologically acceptable acid is oxalic acid, ethylenediamine tetraacetic acid, carbonic acid, or citric acid; the physiologically acceptable base is sodium bicarbonate, potassium bicarbonate, sodium carbonate, or potassium carbonate; and the physiologically acceptable salt is calcium chloride, potassium chloride or sodium chloride.

14. A composition of matter comprising an aqueous buffer solution containing

a physiologically acceptable acid selected from the group consisting of oxalic acid, ethylenediamine tetraacetic acid, carbonic acid, and citric acid;

a physiologically acceptable base; and

a physiologically acceptable salt selected from the group consisting of calcium chloride, potassium chloride, and sodium chloride, wherein the ratio of acid to base to salt is 0.1 to 0.0001M (acid) : 1 to 0.001M (base) : 10 to 0.01M (salt) and containing a mixture of native lactoferrin and lactoferrin immobilized on a galactose-rich polysaccharide, collagen, gelatin, fibronectin, casein, mucin, heparan-sulfate, carrageenan, deoxyribonucleic acid, adenosine triphosphate or a triglyceride via the N-terminus region of the lactoferrin, in a native lactoferrin to immobilized lactoferrin molar ratio of from about 1:1 to about 1:5 and in a concentration of from about 0.001 to about 2.5 % wt/vol.

15. The composition in accordance with claim 14, wherein the lactoferrin is immobilized on a galactose-rich polysaccharide.

16. The composition in accordance with claim 14, wherein the mixture comprises about 1% wt/vol immobilized lactoferrin and about 1% wt/vol native lactoferrin.

17. The composition in accordance with claim 14, wherein the physiologically acceptable acid is citric acid, the physiologically acceptable base is sodium bicarbonate and the physiologically acceptable salt is sodium chloride.

18. A method for reducing the microbial contamination of a composition subject to microbial contamination by a microbe, comprising:

treating the composition with a sufficient amount of isolated lactoferrin immobilized on a naturally occurring substrate via the N-terminus region of the lactoferrin to reduce microbial

contamination.

19. The method in accordance with claim 18, wherein the naturally occurring substrate is a protein, a polysaccharide, cellulose, a nucleic acid, a nucleotide or a lipid.

20. The method in accordance with claim 18, wherein the naturally occurring substrate is collagen, gelatin, fibronectin, casein, mucin, heparan-sulfate, carrageenan, deoxyribonucleic acid, adenosine triphosphate or a triglyceride.

21. The method in accordance with claim 18, wherein the naturally occurring substrate is a galactose-rich polysaccharide.

22. The method of claim 18, wherein the composition is an aqueous solution, an aqueous emulsion, a colloid, a suspension, a powder, or a granular solid.

23. The method in accordance with claim 18, further comprising applying a composition containing a mixture of immobilized lactoferrin and native lactoferrin.

24. The method in accordance with claim 23, wherein the concentration of the mixture in the composition is from about 0.001 to about 2.5% wt/vol.

25. The method in accordance with claim 23, wherein the molar ratio of immobilized lactoferrin to native lactoferrin in the mixture is in a ratio of from about 1:1 to about 1:10.

26. The method in accordance with claim 23, wherein the molar ratio of immobilized lactoferrin to native lactoferrin in the mixture is in a ratio of from about 1:1 to about 1:5.

27. The method in accordance with claim 23, wherein the mixture comprises about 1% wt/vol immobilized lactoferrin and about 1% wt/vol native lactoferrin.

28. The method in accordance with claim 18, wherein the aqueous solution further comprises a buffer system.

29. The method in accordance with claim 28, wherein the buffer system contains a physiologically acceptable acid, a physiologically acceptable base, and a physiologically acceptable salt.

30. The composition in accordance with claim 29, wherein the physiologically acceptable acid is oxalic acid, ethylenediamine tetraacetic acid, carbonic acid, or citric acid; the physiologically acceptable base is sodium bicarbonate, potassium bicarbonate, sodium carbonate, or potassium carbonate; and the physiologically acceptable salt is calcium chloride, potassium chloride or sodium chloride.

31. The method of claim 18, wherein the microbe is bacterium, a fungus, a protozoan, or a virus.

32. The method in accordance with claim 18, wherein the microbe is enterotoxigenic *Escherichia coli*, enteropathogenic *Escherichia coli*, *Shigella dysenteriae*, *Shigella flexneri*, *Salmonella typhimurium*, *Salmonella typhi*, *Salmonella abony*, *Salmonella dublin*, *Salmonella enteritidis*, *Salmonella hartford*, *Salmonella kentucky*, *Salmonella panama*, *Salmonella pullorum*, *Salmonella rostock*, *Salmonella thompson*, *Salmonella virschow*, *Enterobacter aerogenes*, *Vibrio cholerae*, *Yersinia enterocolitica*, *Campylobacter jejuni*, *Aeromonas hydrophila*, *Staphylococcus aureus*, *Staphylococcus hyicus*, *Staphylococcus epidermidis*, *Staphylococcus hominis*, *Staphylococcus warneri*, *Staphylococcus xylosus*, *Staphylococcus chromogenes*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Streptococcus mutans*, *Streptococccus sanguis*; *Pediococcus acne*, *Bacillus cereus*, *Bacillus anthracis*,*Bacillus subtilis*, a *Brucella* species, *Listeria monocytogenes*, *Legionella pneumophila*, *Bordetella pertussis*, *Pseudomonas aeruginosa*, *Legionella pneumophila*, *Francisella tularensis*, *Candida albicans*, *Brochothrix thermospacta*, *Bacillus pumilus*, *Enterococcus faecium*, *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Deinococcus radiopugnans*, *Deinococcus radiodurans*, *Deinobacter grandis*, *Acinetobacter radioresistens*, or *Methylobacterium radiotolerans*.

33. The method in accordance with claim 18, wherein the microbe is a verotoxic *Escherichia coli*.

34. The method in accordance with claim 33, wherein the verotoxic *Escherichia coli* is the serotype O157:H7.

35. The method of Claim 18, wherein the microbe is a *Clostridium* species.

36. The method of Claim 35, wherein species is *Clostridium perfringens*, *Clostridium difficile*, *Clostridium botulinum*, or *Clostridium tetani*.

37. The method of Claim 18, wherein the microbe is a protozoan selected from the group consisting of *Entamoeba histolytica*, *Naegleria flowleri*, *Giardia lamblia*, *Leishmania spp.*, *Trichomonas vaginalis*, *Trypanosoma spp.*, *Plasmodium spp.*, or *Taxoplasma spp.*

38. The method in accordance with claim 18, wherein the concentration of lactoferrin on the surface of the composition subject to microbial contamination is from about 0.0001 to about 10 mg /sq.inch.

39. The method in accordance with claim 38, wherein the concentration lactoferrin on the surface of the composition subject to microbial contamination is from about 0.01 to about 1 mg/sq. inch.

40. A method for inhibiting the microbial contamination of a composition subject to microbial contamination comprising treating the composition with an aqueous buffer solution containing

a physiologically acceptable acid selected from the group consisting of oxalic acid, ethylenediamine tetraacetic acid, carbonic acid, and citric acid;

a physiologically acceptable base; and

a physiologically acceptable salt selected from the group consisting of calcium chloride, potassium chloride, and sodium chloride, wherein the ratio of acid to base to salt is 0.1 to 0.0001M (acid) : 1 to 0.001M (base) : 10 to 0.01M (salt) and containing a mixture of native lactoferrin and lactoferrin immobilized on a galactose-rich polysaccharide, collagen, gelatin, fibronectin, casein, mucin, heparan-sulfate, carrageenan, deoxyribonucleic acid, adenosine triphosphate or a triglyceride via the N-terminus region of the lactoferrin, in a native lactoferrin to immobilized lactoferrin molar ratio of from about 1:1 to about 1:5 and in a concentration of from about 0.001 to about 2.5 % wt/vol.

41. The method in accordance with claim 40, wherein the lactoferrin is immobilized on galactose-rich polysaccharide.

42. The method in accordance with claim 40, wherein the mixture comprises about 1% wt/vol immobilized lactoferrin and about 1% wt/vol native lactoferrin.

43. The method in accordance with claim 40, wherein the physiologically acceptable acid is citric acid, the physiologically acceptable base is sodium bicarbonate and the physiologically acceptable salt is sodium chloride.

44. The method of claim 40, wherein the microbe is bacterium, a fungus, a protozoan, or a virus.

45. The method in accordance with claim 40, wherein the microbe is enterotoxigenic *Escherichia coli*, enteropathogenic *Escherichia coli*, *Shigella dysenteriae*, *Shigella flexneri*, *Salmonella typhimurium*, *Salmonella typhi*, *Salmonella abony*, *Salmonella dublin*, *Salmonella enteritidis*, *Salmonella hartford*, *Salmonella kentucky*, *Salmonella panama*, *Salmonella pullorum*, *Salmonella rostock*, *Salmonella thompson*, *Salmonella virschow*, *Enterobacter aerogenes*, *Vibrio cholerae*, *Yersinia enterocolitica*, *Campylobacter jejuni*, *Aeromonas hydrophila*, *Staphylococcus aureus*, *Staphylococcus hyicus*, *Staphylococcus epidermidis*, *Staphylococcus hominis*, *Staphylococcus warneri*, *Staphylococcus xylosus*, *Staphylococcus chromogenes*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Streptococcus mutans*, *Streptococccus sanguis*; *Pediococcus acne*, *Bacillus cereus*, *Bacillus anthracis*,*Bacillus subtilis*, a *Brucella* species, *Listeria monocytogenes*, *Legionella pneumophila*, *Bordetella pertussis*, *Pseudomonas aeruginosa*, *Legionella pneumophila*, *Francisella tularensis*, *Candida albicans*, *Brochothrix thermospacta*, *Bacillus pumilus*, *Enterococcus faecium*, *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Deinococcus radiopugnans*, *Deinococcus radiodurans*, *Deinobacter grandis*, *Acinetobacter radioresistens*, or *Methylobacterium radiotolerans*.

46. The method in accordance with claim 40, wherein the microbe is a verotoxic *Escherichia coli*.

47. The method in accordance with claim 46, wherein the verotoxic *Escherichia coli* is the serotype O157:H7.

48. The method of Claim 40, wherein the microbe is a *Clostridium* species.

49. The method of Claim 48, wherein species is *Clostridium perfringens*, *Clostridium difficile*, *Clostridium botulinum*, or *Clostridium tetani*.

50. The method in accordance with claim 40, wherein the ratio of acid to base to salt is 0.1 to 0.0001M (acid) : 1 to 0.001M (base) : 10 to 0.01M (salt).

51. The method in accordance with claim 40, wherein the ratio of acid to base to salt is 0.01-0.001M (acid) : 0.1 to 0.01M (base) : 1 to 0.1M(salt).

52. The method in accordance with claim 40, wherein the ratio of acid to base to salt is 0.1 to 0.0001M (acid) : 1 to 0.001M (base) : 10 to 0.01M (salt).

53. The method in accordance with claim 40, wherein the ratio of acid to base to salt is 0.01-0.001M (acid) : 0.1 to 0.01M (base) : 1 to 0.1M(salt).

54. The method in accordance with claim 40, wherein the ratio of acid to base to salt is 0.1 to 0.0001M (acid) : 1 to 0.001M (base) : 10 to 0.01M (salt).

55. The method in accordance with claim 40, wherein the ratio of acid to base to salt is 0.01-0.001M (acid) : 0.1 to 0.01M (base) : 1 to 0.1M(salt).

56. The method in accordance with claim 18, wherein the composition subject to microbial contamination is a foodstuff.

57. The method in accordance with claim 56, wherein the foodstuff is a meat product.

58. The method of claim 57, wherein the meat product is a beef product, a pork product, or a poultry product.

59. The method in accordance with claim 40, wherein the composition subject to microbial contamination is a foodstuff.

60. The method in accordance with claim 59, wherein the composition is a meat product.

61. The method of Claim 60, wherein the meat product is a beef product, a pork product, or a poultry product.

62. The method of claim 57, wherein the meat product is veal, lamb, sheep, goat, elk, deer, antelope, horse, or dog.

63. The method of claim 60, wherein the meat product is veal, lamb, sheep, goat, elk, deer, antelope, horse, or dog.

64. The method of claim 56, wherein the foodstuff comprises a surface and/or flesh of a marine or freshwater aquatic organism.

65. The method of claim 64, wherein the aquatic organism is a fish, mollusk, or crustacean.

66. The method of claim 59, wherein the foodstuff comprises a surface and/or flesh of a marine or freshwater aquatic organism.

67. The method of claim 66, wherein the aquatic organism is a fish, mollusk, or crustacean.

68. The method of claim 56, wherein the foodstuff comprises a vegetable foodstuff.

69. The method of claim 59, wherein the composition comprises a vegetable foodstuff.

70. A method for reducing the microbial contamination of a meat product subject to microbial contamination by a microbe, comprising:

applying to the meat product a composition containing

a physiologically acceptable acid selected from the group consisting of oxalic acid, ethylenediamine tetraacetic acid, carbonic acid, and citric acid;

a physiologically acceptable base; and

a physiologically acceptable salt selected from the group consisting of calcium chloride, potassium chloride, and sodium chloride, wherein the molar ratio of acid to base to salt is 0.1 to 0.0001 (acid) : 1 to 0.001 (base) : 10 to 0.01 (salt) and containing a mixture of native lactoferrin and lactoferrin immobilized on a galactose-rich polysaccharide, collagen, gelatin, fibronectin, casein, mucin, heparan-sulfate, carrageenan, deoxyribonucleic acid, adenosine triphosphate or a triglyceride via the N-terminus region of the lactoferrin, in a native lactoferrin to immobilized lactoferrin molar ratio of from about 1:1 to about 1:5 and in a concentration of from about 0.001 to about 2.5 % wt/vol.

71. The method of claim 70, wherein the composition is an aqueous solution, an aqueous emulsion, a colloid, a suspension, a powder, or a granular solid.

72. The method in accordance with claim 70, wherein the lactoferrin is immobilized on a galactose-rich polysaccharide.

73. The method in accordance with claim 70, wherein the mixture comprises about 1% wt/vol immobilized lactoferrin and about 1% wt/vol native lactoferrin.

74. The method in accordance with claim 70 wherein the physiologically acceptable acid is citric acid, the physiologically acceptable base is sodium bicarbonate and the physiologically acceptable salt is sodium chloride.

75
~~78~~. The method of claim 70, wherein the microbe is bacterium, a fungus, a protozoan, or a virus.

76
~~79~~. The method in accordance with claim 70, wherein the microbe is enterotoxigenic *Escherichia coli*, enteropathogenic *Escherichia coli*, *Shigella dysenteriae*, *Shigella flexneri*, *Salmonella typhimurium*, *Salmonella typhi*, *Salmonella abony*, *Salmonella dublin*, *Salmonella enteritidis*, *Salmonella hartford*, *Salmonella kentucky*, *Salmonella panama*, *Salmonella pullorum*, *Salmonella rostock*, *Salmonella thompson*, *Salmonella virschow*, *Enterobacter aerogenes*, *Vibrio cholerae*, *Yersinia enterocolitica*, *Campylobacter jejuni*, *Aeromonas hydrophila*, *Staphylococcus aureus*, *Staphylococcus hyicus*, *Staphylococcus epidermidis*, *Staphylococcus hominis*, *Staphylococcus warneri*, *Staphylococcus xylosus*, *Staphylococcus chromogenes*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Streptococcus mutans*, *Streptococccus sanguis*; *Pediococcus acne*, *Bacillus cereus*, *Bacillus anthracis*,*Bacillus subtilis*, a *Brucella* species, *Listeria monocytogenes*, *Legionella pneumophila*, *Bordetella pertussis*, *Pseudomonas aeruginosa*, *Legionella pneumophila*, *Francisella tularensis*, *Candida albicans*, *Brochothrix thermospacta*, *Bacillus pumilus*, *Enterococcus faecium*, *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Deinococcus radiopugnans*, *Deinococcus radiodurans*, *Deinobacter grandis*, *Acinetobacter radioresistens*, or *Methylobacterium radiotolerans*.

77
~~80~~. The method in accordance with claim 70, wherein the microbe is a verotoxic *Escherichia coli*.

78
~~81~~. The method in accordance with claim 80, wherein the verotoxic *Escherichia coli* is the serotype O157:H7.

79
~~82~~. The method of claim 70, wherein the microbe is a *Clostridium* species.

80
~~83~~. The method of claim 82, wherein species is *Clostridium perfringens*, *Clostridium difficile*, *Clostridium botulinum*, or *Clostridium tetani*.

81
~~84~~. The method in accordance with claim 70 wherein the concentration of lactoferrin on the surface of the meat product is from about 0.0001 to about 10 mg /sq.inch.

82 85. The method in accordance with claim 70, wherein the concentration of lactoferrin on the surface of the meat product is from about 0.01 to about 1 mg/sq. inch.

83 86. The method in accordance with claim 70, wherein the meat product is a beef product, a pork product, or a poultry product.

84 87. The method of claim 70, wherein the meat product is veal, lamb, sheep, goat, elk, deer, antelope, horse, or dog.

85 88. A foodstuff, containing:

isolated lactoferrin immobilized on a naturally occurring substrate via the N-terminus region of the lactoferrin in a concentration between about 0.0001 and about 10 mg per gram of the foodstuff.

86 89. The foodstuff in accordance with claim 88, wherein the composition is a meat product.

87 90. The meat product of Claim 89, wherein the meat product is a beef product, a pork product, or a poultry product.

88 91. The meat product of claim 90, wherein the meat product is veal, lamb, sheep, goat, elk, deer, antelope, horse, or dog.

89 92. The foodstuff of claim 88, wherein the foodstuff comprises a surface and/or flesh of a marine or freshwater aquatic organism.

90 93. The foodstuff of claim 92, wherein the aquatic organism is a fish, mollusk, or crustacean.

91 94. The foodstuff of claim 88, wherein the foodstuff comprises a vegetable foodstuff.

92 95. The foodstuff of claim 88, wherein said foodstuff is a packaged foodstuff.

93 96. A method of inhibiting the growth and/or adhesion of a microbial species on a foodstuff, comprising:

treating a food-contacting surface of a material for food packaging or food handling with an

immobilized lactoferrin; and

contacting a foodstuff with said surface, whereby the growth and/or adhesion of a microbial species on said foodstuff is inhibited.

97. The method of Claim 96, wherein said food packaging or handling material is a cellulosic polymer.

98. The method of Claim 96, wherein said food packaging or handling material is paper, wood, or cardboard.

99. The method of Claim 96, wherein said food-contacting surface comprises a surface belonging to a shear wrap, a cellophane, a wrapping paper, a waxed paper, a bag, a carton, a box, a tray, a plate, a bowl, a food storage vessel, a serving dish, a cup, a bin, a jar, or a bottle.

100. The method of Claim 96, wherein said food-contacting surface comprises a surface belonging to a glove, a mitt, a fork, a spoon, a knife, a slicer, a tong, a ladle, a scoop, a cup, a processor, a juicer, a grinder, a press, a hook, a chipper, a peeler, a cutter, a screw, an opener, a chute, a spatula, a cutting board, a kneading board, a rack, or a shelf.

101. A food container or food-handling implement, said container or implement having a food-contacting surface, said surface treated with an immobilized lactoferrin in an amount effective to inhibit the growth and/or adhesion of a microbial species on said surface.

102. The food container or food-handling implement of Claim 121, wherein said container or implement is a shear wrap, a cellophane, a wrapping paper, a waxed paper, a bag, a carton, a box, a tray, a plate, a bowl, a food storage vessel, a serving dish, a cup, a bin, a jar, a bottle, a glove, a mitt, a fork, a spoon, a knife, a slicer, a tong, a ladle, a scoop, a cup, a processor, a juicer, a grinder, a press, a hook, a chipper, a screw, a cutter, a peeler, an opener, a chute, a spatula, a cutting board, a kneading board, a rack, or a shelf.

103. The food container or food-handling implement of Claim 121, having an amount of a between about 0.0001 to about 10 mg /square inch of said food-contacting surface.

104. An antimicrobial cleanser, polish, paint, spray, soap, or detergent for applying to an inanimate surface, containing an immobilized lactoferrin in an amount effective to inhibit the growth and/or adhesion of a microbial species on said surface.